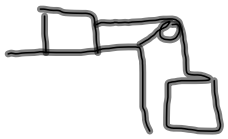
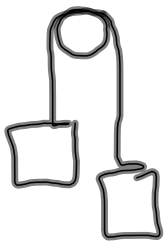
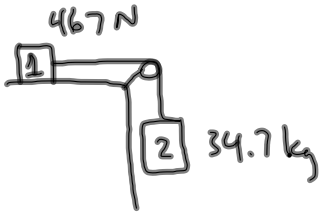
Test Topics:

- Net forces (force triangles)
- 1-D forces (x- or y-direction)
- Tug-of-war
- Friction
  - Pulling horizontally
  - Pulling at an angle
- Pulley I 
- Pulley II 
- Conceptual questions about forces and Newton's laws
  - You will have to know Newton's laws!

Pulley Practice Problems 3.13.12 Honors Physics

A 467 N block on a table is attached, via a rope and pulley, to another block of mass 34.7 kg that hangs off the table. If we ignore friction, what would the acceleration of the blocks be?

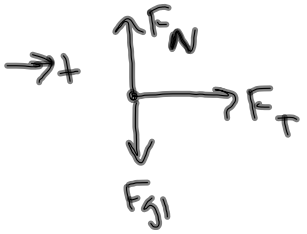


$$F_{g1} = m_1 g_g$$

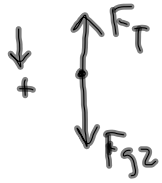
$$m_1 = \frac{F_{g1}}{g_g} = \frac{467\ N}{9.8\ m/s^2}$$

$$= 47.65\ kg$$

FBD 1:



FBD 2:



$$\sum F_1 = m_1 a \qquad \sum F_2 = m_2 a$$

$$F_T = m_1 a \qquad F_{g2} - F_T = m_2 a$$

$$F_{g2} - m_1 a = m_2 a$$

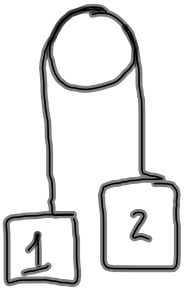
$$a(m_1 + m_2) = F_{g2} = m_2 g_g$$

$$a = \frac{m_2 g_g}{m_1 + m_2}$$

$$= \frac{(34.7\ kg)(9.8\ m/s^2)}{47.65\ kg + 34.7\ kg}$$

$$= 4.13\ m/s^2$$

Pulley II Problems:

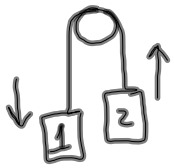


Mass	1 goes...	2 goes...
$m_1 = m_2$	nowhere	nowhere
$m_1 > m_2$	down	up
$m_1 < m_2$	up	down

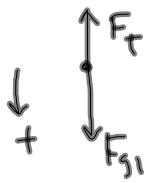
- Variables that are the same for both:
  - F_T (tension on rope)
  - acceleration
- There will be a different positive direction for each mass.
- Make the positive direct the direction of acceleration.

Pulley Practice Problems 3.13.12 Honors Physics

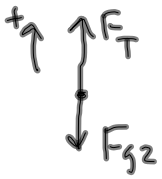
Two hanging blocks (block 1 mass = 8.0 kg; block 2 mass = 5.0 kg) are attached by a rope that is hung over a frictionless pulley.
a) Which way does each block accelerate?
b) What is the magnitude of the acceleration?



FBD 1:



FBD 2:



$\Sigma F_1 = m_1 a$ $\quad$ $\Sigma F_2 = m_2 a$

$F_{g1} - F_T = m_1 a$ $\quad$ $F_T - F_{g2} = m_2 a$

$F_T = F_{g2} + m_2 a$

$F_{g1} - (F_{g2} + m_2 a) = m_1 a$

$F_{g1} - F_{g2} - m_2 a = m_1 a$

$m_1 a + m_2 a = F_{g1} - F_{g2}$

$a(m_1 + m_2) = F_{g1} - F_{g2}$

$a = \frac{F_{g1} - F_{g2}}{m_1 + m_2}$ $\quad$ $F_{g1} = m_1 g$ $\quad$ $F_{g2} = m_2 g$

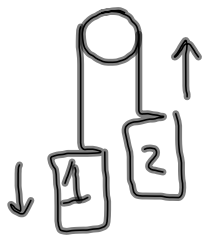
$= \frac{m_1 g - m_2 g}{m_1 + m_2}$

$= \frac{(8\text{ kg})(9.8\text{ m/s}^2) - (5\text{ kg})(9.8\text{ m/s}^2)}{8\text{ kg} + 5\text{ kg}}$

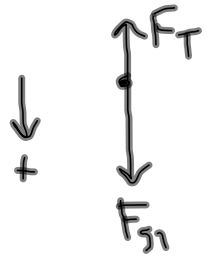
$= 2.26\text{ m/s}^2$

Pulley Practice Problems 3.13.12 Honors Physics

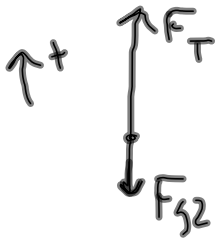
Two masses are hanging by a rope passed over a pulley. The mass on the left is 7.89 kg, and the mass on the right is 6.87 kg. What is the acceleration of the block on the right?



FBD 1:



FBD 2:



$\Sigma F_1 = m_1 a$ $\quad$ $\Sigma F_2 = m_2 a$

$F_{g1} - F_T = m_1 a$ $\quad$ $F_T - F_{g2} = m_2 a$

$F_T = F_{g2} + m_2 a$

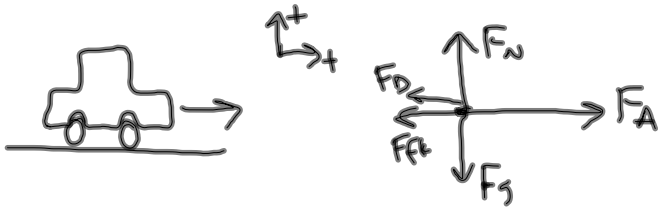
$F_{g1} - F_{g2} - m_2 a = m_1 a$

$$a = \frac{m_1 a_g - m_2 a_g}{m_1 + m_2}$$

$$= 0.677 \text{ m/s}^2$$

Pulley Practice Problems 3.13.12 Honors Physics

A car of mass 1155 kg is moving at a constant velocity to the right, with a force of drag equal to 45 N and a coefficient of friction of 0.233. What is the applied force necessary to keep the car moving at a constant velocity?



$$\sum F_x = Ma_x \rightarrow 0$$

$$F_A - F_{fk} - F_D = 0$$

$$F_A = F_D + F_{fk}$$

$$= 45\,N + 2637\,N = 2682\,N$$

$$F_{fk} = \mu_k F_N$$

$$= (.233)(11319\,N)$$

$$= 2637\,N$$

$$\sum F_y = 0$$

$$F_N - F_g = 0$$

$$F_N = F_g$$

$$= ma_g$$

$$= (1155\,kg)(9.8\,m/s^2)$$

$$= 11319\,N$$